IDENTIFYING KEY RISK AREAS FOR UK AVIATION

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1 INTRODUCTION

This Paper describes how SRG has addressed a major challenge - to improve aviation safety in the future, and it illustrates how SRG has developed a process to proactively address the significant safety issues. This process makes use of the best available information and expertise to identify key safety risks and then define a realistic safety improvement plan, taking account of the finite resources that are available. This systematic way of addressing safety risk is a new way for SRG to carry-out the business of regulating aviation safety. In addition, the Paper addresses a number of safety data collection and analysis issues that are of relevance to the GAIN initiative.

2 BACKGROUND - WORLD-WIDE AVIATION SAFETY

Commercial air transport has enjoyed substantial growth over the past 30 years. Passengers carried each year on world-wide scheduled services have increased from just over 100 million in the mid 1960s to more than 1000 million today. This is a tenfold increase in the number of passenger carried in just over 30 years.

Over the same period, safety has also improved by a factor of ten. In the mid 1960s the world-wide fatal accident rate for commercial passenger jets was about 5 per million flights whereas today it has reduced to 0.5 per million flights. So, as the number of passengers carried has increased ten times, the accident rate has reduced ten times - this is an impressive achievement.

Air transport now provides the safest mode of transport in terms of fatalities per passenger-kilometre. Over the past 10 years, there have been an average of 1184 fatalities per annum in aircraft above 5700kg on world-wide public transport operations (except for operations in the Commonwealth of Independent States (CIS)). The number of fatalities and accidents appear to have stabilised over this period (see Figures 1 and 2).

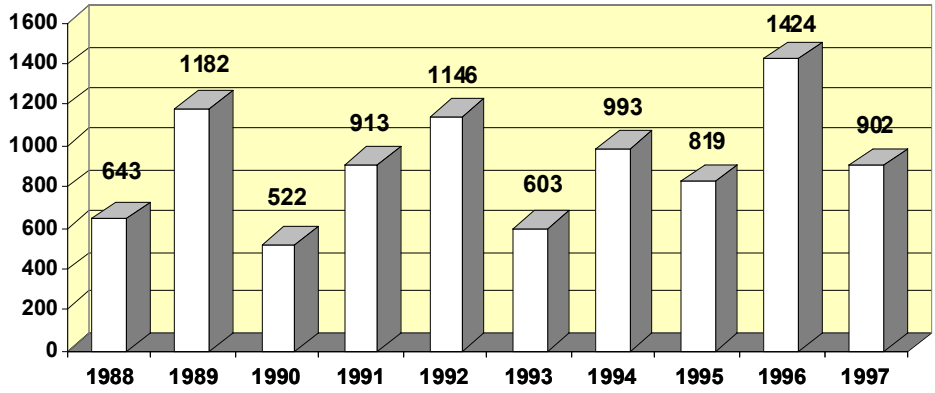

Figure 1 - World-wide Public Transport Fatalities
(Data from Commonwealth of Independent States not included)

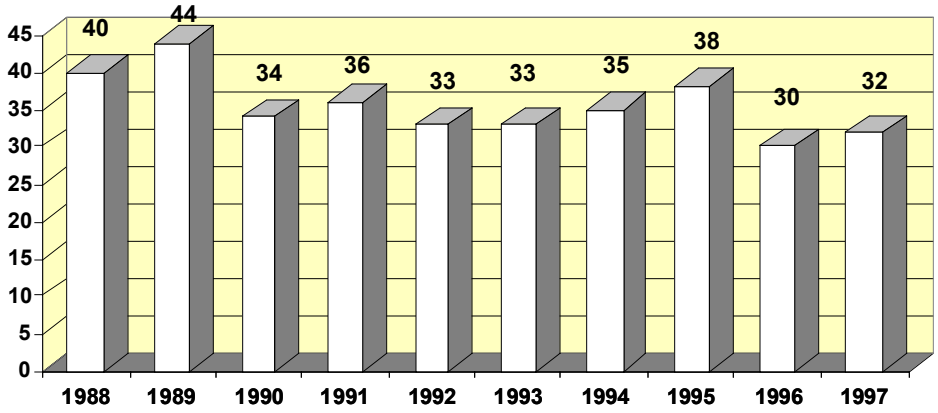

Figure 2 - World-wide Public Transport Fatal Accidents
(Data from Commonwealth of Independent States not included)

For JAA and FAA operators, over the past 10 years, they have generated almost 70% of the world's commercial jets flights and have had an average of 235 fatalities per annum, or 20% of the total.

For the UK, the safety record has been better still. The UK has generate almost 4% of the world's jet flights and have had an average of 6.5 fatalities per annum, or 0.5% of the total. Although these appear to be small numbers, the UK operation is by no means small. Last year, UK operators generated just over 1 million public transport flights, 2 million revenue flight hours and carried about 80 million revenue passengers.

Add to this all the foreign operations into UK airspace and aerodromes and general aviation (we have about 14,000 general aviation aircraft registered in the UK as well as 37,000 private and 15,000 professional pilot holders) and you can see the UK has a very active aviation operation.

In spite of all these very encouraging safety statistics, many safety observers have become very concerned that the global fatal accident rate has stabilised and, if nothing is done to improve it, any further growth in commercial air traffic will lead to an unacceptable increase in the absolute number of fatal accidents.

It is now widely accepted that new, proactive means of improving safety have to be developed by all involved in commercial air transport. For this reason, SRG has developed a new way to identify, achieve and monitor safety improvements as an integral part of its future business planning process..

3 THE UK SAFETY IMPROVEMENT PROCESS

Over the past 18 months, SRG has developed a process to assess aviation safety in the UK so that the finite resources available in SRG and Industry may be targeted on the issues of greatest safety risk. This process is of fundamental importance to SRG because it is to be used as the basis for our Business Planning to ensure that business effectiveness, efficiency and flexibility are optimised.

The new process assesses various safety information sources in a formal and accountable way and presents this information to SRG Management in a timely manner to allow them to plan future activities. This Paper explains this new process and how SRG has identified the key risk areas for UK aviation.

4 SRG'S PERSPECTIVE

SRG's role is to ensure that high safety standards for UK civil aviation are set and achieved in a co-operative and cost effective manner. Its strategic objective for safety improvement, is to ensure that the frequency of fatal accidents does not increase in line with forecast growth in traffic by developing safety improvement concepts and a safety improvement action programme, in partnership with industry.

SRG fulfils its primary responsibilities by developing policies and standards for the certification, maintenance and operation of UK registered aircraft, the licensing of aviation personnel, air traffic services and aerodromes and provides advice for ministers, industry and the public. Some of these activities are supported by SRG internally funded safety research.

5 THE CURRENT SITUATION

Aviation safety is a subject of major public concern. There has been a plethora of world-wide safety initiatives - Commercial Aviation Safety Strategy Team (CASST), Global Air Safety Program (GASP), the Gore Report, Global Analysis & Information Network (GAIN), FAA's 'Safer Skies', JAA Safety Strategy Initiative (JSSI), etc., and concern has been expressed about the overlaps, competing agendas and the diverse outcomes. It is clear from these initiatives that something has to be done, but it is not so clear how the required 'global' safety improvements are to be achieved.

Previous attempts at this type of analysis have been criticised for being too focused on historical causes, and therefore being ineffective in predicting accidents occurring due to "new" causes. This is being addressed by using subjective feedback from our own experts, by our processes which subject new/emerging technologies to rigorous examination, and by undertaking proactive systematic safety research and analysis, but this risk will always exist.

In response to these internal and external pressures, SRG has developed a process to identify key risk areas for UK aviation so that resources may be efficiently deployed.

6 SRG KEY RISK IDENTIFICATION PROCESS

Although the UK safety record is amongst the best in the world, it was recognised in 1997 that the pressures on SRG of

- Increasing aviation activity,
- Finite SRG resources,
- Need for greater flexibility,
- Changes in technology,
- Harmonisation of regulations,

could lead to excessive staff workload and reduced efficiency and effectiveness. It was agreed in 1997 under the SRG Change Programme initiative on 'Risk Based Resource Allocation' that a process should be developed for identifying Key Safety Risks so that SRG's finite resources could be prioritised so that safety improvements could be realised. The resulting process was agreed by the SRG Executive Committee in February this year.

Soon after, the process brought together a small group of representatives from eight SRG Technical and Operational Departments called the Risk Assessment for Resource Evaluation (RARE) Group. The Group's initial task has been to identify the 'Top Ten' safety issues for UK aviation.

The new process for identifying key safety risk issues makes use of the following information sources:-

- Global Fatal Accident Review (CAP 681)
- UK Mandatory Occurrence Reports
- SRG Expert Judgement (Questionnaire)
- Subjective Opinion
- AAIB Accident Reports
- Industry/Relevant professional bodies
- Public/Press

This information was presented to the RARE Group for assessment and the results were then presented to SRG's Executive Committee, as shown in Figure 3 below.

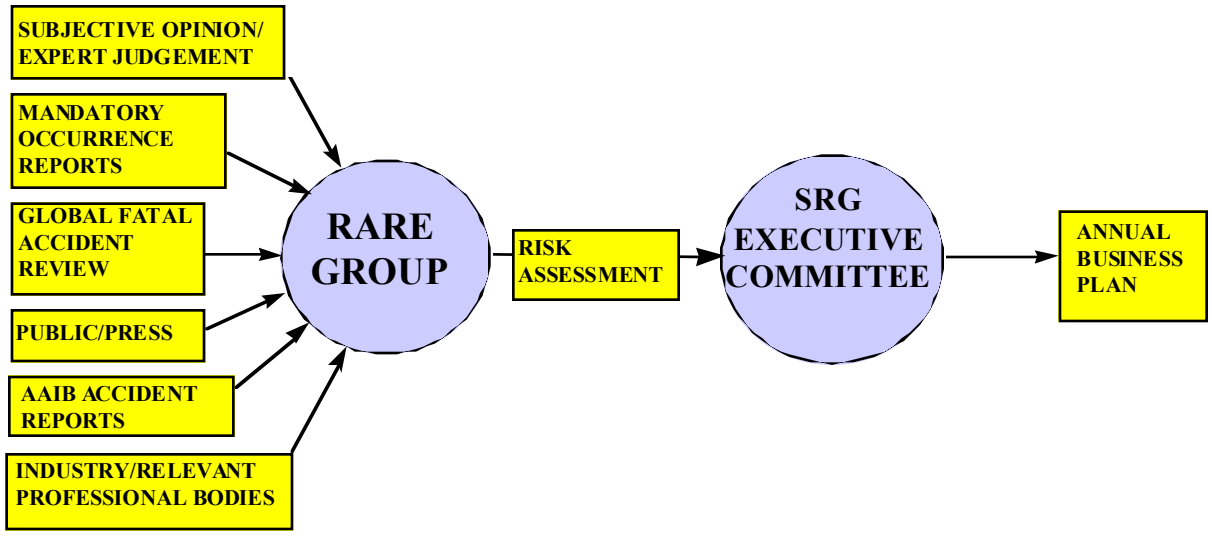

Figure 3 - The SRG Risk Assessment & Resource Allocation Process

7 GLOBAL FATAL ACCIDENT REVIEW

To identify the Top Ten issues, the RARE Group focused on the Global Fatal Accident Review, 1980-1996, (CAP 681). From this, an internal working paper was prepared giving a possible 'Top Ten' items for consideration, taking account of the most frequently occurring causal factors, circumstantial factors and outcomes of accidents.

A ***causal factor*** was an event or item which was judged to be directly instrumental in the causal chain of events leading to the accident, eg. systems failure, omission of action, flight handling problem. The highest number of causal factors recorded for a single accident was eleven and the average per accident was 3.3.

A ***circumstantial factor*** was an event or item which was judged not to be directly in the causal chain of events but could have contributed to the accident. These factors were present in the situation and were felt to be potentially relevant to the accident, although not directly causal. For example, it was useful to note when an aircraft had made a Controlled Flight Into Terrain (CFIT) and it was not fitted with a Ground Proximity Warning System (GPWS). Although GPWS was not mandatory for all aircraft considered in the study, the non-fitment of a GPWS could have been considered circumstantial, but not causal, in a CFIT type accident. The highest number of circumstantial factors for a single accident was seven and the average per accident was 2.2.

Consequences recorded the outcomes of the fatal accidents in terms of collisions, structural failure, fire, fuel exhaustion and other events. It was important to keep a record of the consequences as all fatal accidents consist of a chain of events with a final outcome resulting in fatalities. In some cases, it can be just as important to know what happened rather than why or how it happened as a particular combination of causal factors on one day may lead to a fatal accident whilst on the following day it may only result in a minor incident. In many cases, the consequence is all that is remembered about a particular event. The highest number of consequences in a single accident was five and the average number per accident was 1.8.

The chain of events used in the Global Review is illustrated in Figure 4 below and an example in Figure 5 overleaf.

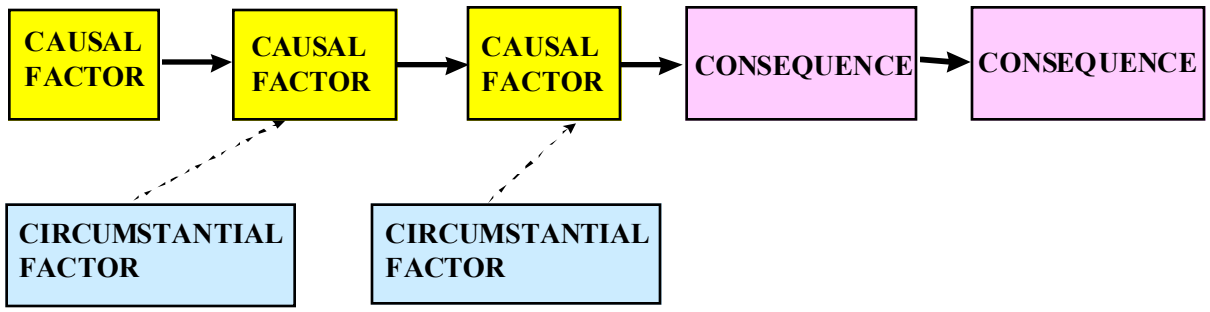

Figure 4 - The Chain of Events

To identify the 'Top Ten' issues, the Group focused on identifying the most frequent causal factors for all the accidents in the Review. This was subsequently refined to identify JAA and FAA operators, and then JAA and then, finally, reduced to UK accidents. No significant inconsistencies were found, though it was felt that the UK sample of 13 accidents since 1980 was below a size from which meaningful conclusions could be drawn. In addition, the UK accidents have been thoroughly dealt with in actions taken following CAA's responses to the appropriate AAIB recommendations.

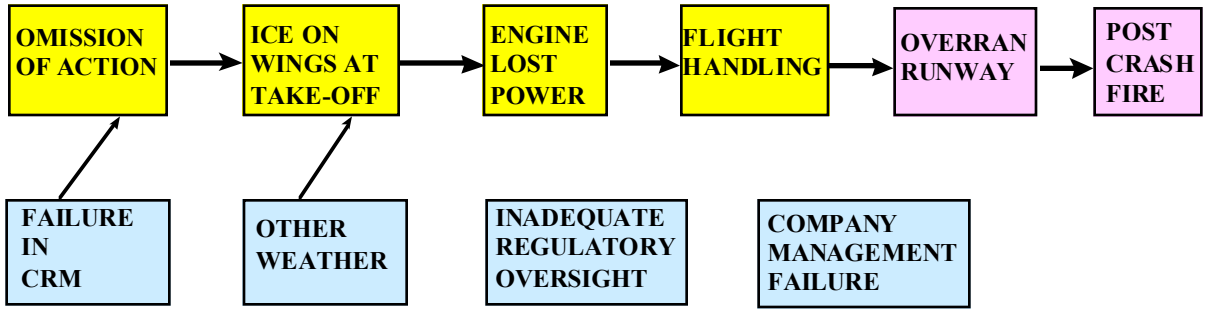

Figure 5 - Example of a Jet Aircraft Take-off Accident

Two current safety issues which are the subject of ongoing work in Europe and USA are "Controlled Flight into Terrain (CFIT)" and "Approach and Landing Accidents". We believe that while the abbreviation CFIT, and the flight phase description are well known, they are not specific enough to enable meaningful actions to be taken. For example, in a CFIT scenario, the primary causal factor could have been "Lack of positional awareness" or "Omission of action - by descending below Decision Height without adequate reference," while a major contributory or circumstantial factor could be the "Failure to fit currently available safety equipment". In each case we have tried to be more specific and describe the actual causal factor, rather than the consequence or flight phase in which it occurred, so we may confidently claim to have addressed and included these issues in our study.

Other Information Sources
The UK Mandatory Occurrence Reports, JAAP/JAWG (ie. UK Airprox) Reports, items of public and political interest and the results of the CAA's own Expert Opinion Survey were also considered by the Group. This work led to the inclusion of "Failure to Maintain Safe Separation" and "Maintenance Human Factors".

8 TOP TEN SAFETY ISSUES

In response to the need to improve aviation safety in the future, SRG has developed a process to identify key risk areas so that the finite resources can be allocated effectively.

The process described has lead to the identification of the Top Ten safety risk issues for UK aviation listed below. These items comprise:-
- the Causal and Circumstantial Factors occurring most frequently and likely to cause the greatest loss of life,
- the items of most concern arising from the most frequent Consequences, UK Mandatory Occurrence Reports and 'expert' opinion', and
- the issues arising from the Global Fatal Accident Review.

Complete prioritisation is inevitably imprecise, but the first item in the list - "Crew and Human Factors" - is the most significant by a large margin.

The Top Ten safety risk issues for UK aviation are:-

- Crew and Human Factors
  - Omission of Action / Inappropriate Action
  - Flight Handling
  - Poor Professional Judgement/ Airmanship
  - Failure in Crew Resource Management (CRM)
  - Lack of Positional Awareness in the Air
  - Maintenance Human Factors
- Design Related
- Regulatory Oversight
- Company Management
- Failure to Maintain Safe Separation
- Freight, Ferry and Positioning Flights
- Occupant Survivability
- Incorrect / Inadequate Procedures
- Non JAA/FAA Operator Safety
- Failure to Adopt/Fit Best Available Technology

9 SRG BUSINESS PLANNING

Each 'Top Ten' item is now included in the current 1998/99 SRG Business Plan. This is the first attempt at focusing the Business Planning process onto the Key Risk issues and it is reassuring that most subjects are already being addressed. However, some areas are in need of greater attention.

As the Business Planning process takes time, SRG is about to commence developing its 1999/2000 Business Plan for completion in March 1999 and SRG technical and operational Divisions have till the end of 1998 to develop their resource plans to address the Top Ten issues. To support this Divisional activity, more information on General Aviation and Helicopter operations is being provided and our various information sources are to be updated. Also, we are conducting a detailed analysis on world-wide Freighter Operations.

10 FUTURE ACTIVITY

Our immediate task is to present this information to our operating and manufacturing industry to make sure they are fully aware and 'on-board' so that they too can work in partnership with us to optimise our combined resources. SRG's intention to work with others is reflected in its sponsorship of the recently published study into Approach and Landing Accidents using the Global Fatal Accident Review database to support the Flight Safety Foundation's Approach and Landing Accident Reduction (ALAR) initiative.

The process described in this paper is still under development but already provides a defensible basis for justifying the level of resource needed to reduce aviation safety risks and is a robust method for planning SRG's business activities. The process is, therefore, expected to become a valuable business management tool for SRG and is being developed as a matter of priority.

11 SAFETY DATA COLLECTION & ANALYSIS ISSUES

For the GAIN Conference, a number of points are discussed that are of fundamental importance to Safety Analysis generally and the GAIN initiative specifically. These are the matters of the quantity and quality of safety data and the type of safety analysis required.

a) Boundaries on the data set.
Any organisation must ensure is that any safety data collected relates to subjects over which it has some ultimate control. The data needs are, therefore, determined by the nature of the business.

For the UK CAA, we have statutory responsibilities which mean that we need safety data principally focused on:

- All UK Registered aircraft
- All aircraft operating into UK Airspace or UK Aerodromes

If we were a major airline, a small turboprop operator, a helicopter operator, a hot air balloon operator or a manufacturer, our safety data needs would all be very different.

b) Depths of the data set.
The depth of data needed depends on what you want to get out of the data. Are you just monitoring safety or acquiring data so you can develop detailed safety improvement strategies. The depth of data is something only an organisation can determine.

For an aviation regulator, such as CAA, we need to know the more serious hazards or potential hazards for all aspects of aviation, ie. from Balloons to B747s, from Aerodromes to ATC providers. This information allows us to monitor the safety of the overall system.

However, if we detect a serious problem area, such as Level Busts or Maintenance Errors then we need to develop new methods of obtaining more specific in-depth information on human factors.

c) Quality and Quantity of the data.
In general, data collectors have a pretty boring job; entering all the data, trying to make it fit into a rigid coding system, reading bad handwriting. It can be very difficult to get good people to do this.

Also, what happens if, after collecting 15,000 records in, say 3 years, you decide to add a new field into your database. Do you go back over the 15,000 records and back-code the data? Have you got the people who can do this? What happens when data entry staff change - each time they change, so may the way the data is entered onto the database.

Also, when the workload is high, if you have a large number of reports, do you decide to put only so many reports onto the database? How do you decide what is a serious or not serious? These are the issues that challenge the database manager all the time.

d) How long do you collect safety data?
If you have identified a special problem area, you may wish to collect more detailed data. For example, for our Level Busts problem, we have a special data collection and analysis project which will collect data for about 12 months after which we will draw a line under it. Just getting more and more data may not tell us anything new. We just need a statistically significant data set.

e) What kind of analysis?

Safety analysis is a very challenging task and databases should be structured to make the task as easy as possible. Unfortunately, most databases are set-up and get running before anyone has decided how to use the data.

From our experience there are two different ways to analyse safety data. One is 'top down' and the other is 'bottom-up'. To do the safety analysis job properly, you should do both, preferably at the same time. We have described our Global Fatal Accident Review and this was a top-down review which identified high-level safety issues of concern. This was supported by a 'bottom-up' review using our Mandatory Occurrence Reporting Scheme database. Another 'top-down' method is to carry-out an expert staff opinion survey to elicit their safety concerns. This is how CAA identified 'Level Busts' as one of the UK's current safety risks

In comparison, the 'bottom-up' analysis of data is more complex. This must be led by technical specialists who can easily interact with the data and guide the analysts. The most effective analysis of this data is to monitor a set number of significant risks and to identify adverse trends.

f) It is all down to Resources.

To a large extent the quantity and quality of data you record depends on the resources you have available. I recall reading an article written by Mr Kaufman, the Vice Chairman of the Commission on Flight Safety of the Inter-state Aviation Committee in the Russian Federation. He described a system for the retrieval, processing and analysis of FDR data. Virtually all aircraft were equipped with modern FDRs and the airlines had set up about over 100 flight data processing centres staffed, even today, by about 1000 people! In addition, the airlines had acquired automated flight data processing systems. He claimed a few years ago that, along with other measures, the implementation of FDR monitoring had, over 5 years, led to a threefold drop in the number of accidents.

I believe we would be hard pushed to find more than 100 people processing FDR data in the Western World. If risk management is reflected by the resources deployed, we have got a long way to go before we realise the full potential of FDR data.

g) Risks of Analysing Data

Finally, safety analysis can be a very risky undertaking because, sometimes, the conclusions may not be what is expected. Our approach in the UK is not to isolate the analysis function but to try to incorporate it into the routine functions of technical staff. My department will, therefore, carry-out the top-down analysis while the Divisions will carry out the 'bottom-up' analysis. This means that more staff buy into the end result which helps to avoid unnecessary conflict in an organisation.

h) Conclusions

In this section I have emphasised the following points of relevance for the GAIN initiative:

The boundaries of safety data depend on your safety responsibilities,
The depth of data analysis depends on whether you are monitoring or improving safety,
There are many factors that can affect the Quality and Quantity of data,
Specific safety projects only require safety data to be collected over a specific time period,
Your whole organisation should get involved in the analysis function, and
Data Collection and Analysis is all about effectively managing resources.